U.S. Navy Interoperability with its High-End Allies

Kenneth Gause, Catherine Lea, Daniel Whiteneck, Eric Thompson[1]

Center for Strategic Studies
Center for Naval Analyses
4401 Ford Avenue
Alexandria, Virginia 22302-1498

703-824-2000
gausek@cna.org

Abstract

At the dawn of the 21st century, the U.S. Navy is seeking to define its missions across the AORs and how it will carry out those missions. During the Cold War, U.S. forward presence operations in many regions were routine and based on in-place or deployed forces that were designed to counter a large-scale, highly capable threat. Interactions with other navies, which to a large extent were bound together through alliances, were predictable, fashioned as they were to counter an expansionist Soviet aggressor. War fighting strategy easily accomodated how the U.S. Navy viewed its unilateral responsibilities, as well as its responsibilities to its partners. In the post-Cold War era, the large, galvinizing threat is gone, most operations will be at the OOTW level and will be conducted in the littoral, as opposed to the high seas. As a consequence, the U.S. Navy must come to terms with the changing circumstances and assess the best way to synchronize its assets with U.S. goals and objectives, which because of the unstable nature of today's international environment, cannot be assumed to be static in the long term.

U.S. policy statements make it clear that whenever possible, U.S. forces will seek to respond to requirements for military force in concert with other countries. These responses may take the form of ad-hoc coalitions or bilateral actions with other countries, and may or may not have mandates or consent from the United Nations, NATO, or other international bodies. This being the case, a particularly important question in defining the U.S. Navy's role is how will it operate with its key allies. The fact that navies will be less engaged in classical blue water oper-

[1] The oponions expressed in this paper are those of the authors. They do not necessarly represent the oponion of the Department of the Navy or the Center for Naval Anlayses.

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE **OCT 2000**	2. REPORT TYPE	3. DATES COVERED **00-00-2000 to 00-00-2000**

4. TITLE AND SUBTITLE **U.S. Navy Interoperability with its High-End Allies**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Center for Naval Analyses,Center for Strategic Studies,4401 Ford Avenue,Alexandria,VA,22302-1498**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
5th International Command and Control Research and Technology Symposium

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**42**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

ations and instead will be more involved in littoral operations enhances the possibility of improvised multinational naval cooperation. Under these circumstances, achieving interoperability becomes much more complicated, for it is no longer simply a question of standardization and compatibility. Interoperability also involves issues of political will.

At the highest level, nations must be willing and able to organize themselves into a common force and to accomodate each other's operational methods by understanding their doctrine, culture, and interests. Appropriate domestic sanctions must be provided, without which information, supplies and services, communications, and other equipment cannot be shared with coalition partners. At the operational and tactical levels, national elements of the force must be able to exchange information well enough to maintain a common picture of events, and be able to support and sustain each other. Achieving and maintaining a sufficient degree of interoperability will be a primary objective of the multinational command regardless of whether the structure is parallel, integrated, or based on a lead nation. The extent of achieveable interoperability will vary depending upon the composition of the multinational maritime force.

This paper looks at the issue of maritime interoperability, specifically between the U.S. Navy and its high-end allies.[2] Interoperability is defined as "the ability of systems, units and forces to provide services to and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together."[3] To many, this suggests that interoperability is confined to a discussion of technology and connectivity. We believe that this approach is too narrowly constrained. This paper broadens the discussion of interoperability to consider operational and political/cultural dimensions as well. These dimensions are as important, or more important, than issues of technology and connectivity.

This paper examines the U.S. Navy's reasons for pursuing interoperability with allied navies. It then looks at the interoperability gaps between the U.S. Navy and its allies. Key components of interoperability and the unique problems associated with each will be discussed. Finally, interoperability implications for warfare areas will be examined in order to better understand operational gaps that could undermine certain coalition missions.

---

2 High end allies refers to those navies that will not only provide political support in a future coalition, but can be counted on to complement U.S. Navy capabilities by providing special skills or region-specific expertise, supplementing U.S. ships and aircraft, providing additional numbers, or being able to respond more quickly than U.S. forces.

3 Like most NATO definitions, this one was developed in the context of war fighting and a formal alliances structure. As the world has changed, however, the need for interoperability has also changed in several ways. NATO has recently adopted the term "operational interoperability," which recognizes that interoperability is not limited to the narrow technical dimension of simply tying systems together to exchange data, but also involves the ability of coalition partners to share information, create a shared understanding of the situation, collaborate on the development and selection of courses of action, communicate these to all forces or units, and allow forces to work together effectively.

Why the U.S. Navy needs to be interoperable

The U.S. Navy has three reasons to be interoperable with other navies.

1. Interoperability allows the U.S. Navy to operate with foreign navies during a crisis or a conflict.

2. Interoperability requirements between navies result in harmonization programs that have the political benefit of shaping foreign navies.

3. Interoperability with foreign navies is required by U.S. policy.

Operations with coalition navies

Recent history shows that during military contingencies and operations other than war, the U.S. Navy operates in coalitions with allied and friendly navies. Kosovo is the most recent example of this fact. Operations dating back to Desert Shield/Storm reveal the U.S. Navy's ability to work with a wide span of navies in terms of sophistication and capabilities. Depending on the spatial configuration of the theater, the U.S. Navy has been able to segment allies and sequence operations in order to alleviate many interoperability problems, such as deconfliction. At the same time, U.S.-led coalitions have benefited from the participation of high-end allied navies that have contributed significantly, both politically and in terms of military effectiveness, especially in Maritime Interception Operations. Operations such as those in the Persian Gulf and Adriatic have shown that more sophisticated foreign navies can both complement and supplement highly capable U.S. ships and aircraft

Operating with technologically advanced or "high-end" navies, like those of most NATO nations, provides military operational benefits to the U.S. Navy. Specifically, four key areas of potential NATO allied naval contribution are worth noting:

- Development of new guided missile AAW frigates with state-of- the-art 3D radars and surface-to-air missiles with longer ranges (France, Germany, Italy, Spain, U.K.)
- Development of new amphibious ships (Italy, Spain, U.K.)
- Ships for surface surveillance (German, as well as other NATO navies)
- Continued proficiency in a key niche area: MCM (especially Germany, Spain, U.K.)

U.S. interoperability policy

U.S. policy documents on military strategy cite the importance of allies and coalitions for future U.S. operations. For example, the U.S. *National Security Strategy* notes that "the threat and challenges we face demand cooperative,

multinational solutions." A central thrust of this strategy is to "sustain and adapt the security relationships we have with key nations around the world," that is, a policy of engagement.[4] Additionally, the 1997 QDR states that engagement emphasizes coalition operations as a way to: (1) pursue ends, (2) secure national goals, and (3) distribute the burdens of responsibility for international peace and stability across nations.[5] Every level of the U.S. defense establishment, including OSD, the Unified CINCs, the Joint Staff, and the services currently have working relationships with many foreign militaries. These relationships aim to assist friendly nations to develop their own security capabilities that enhance their participation in international coalitions of varying degrees of complexity.

Understanding interoperability

An examination of official U.S. and NATO publications reveals numerous interpretations of the concept of interoperability. Most discuss interoperability in terms of combining systems in the pursuit of operational effectiveness. For example, after parroting the NATO definition of systems being able to work together, the U.S. Department of Defense defines interoperability as:

> The conditions achieved among communications-electronic systems or items of equipment when information or services can be exchanged directly and satisfactorily between them and/or their users.[6]

For the purpose of this analysis, however, this paper attempts to broaden the definition of interoperability to include three types:

1. *Technical interoperability*, like the NATO and DoD definitions concentrates on an exchange of services.

2. *Operational interoperability* considers whether units from different countries operating together can complete a mission.

3. P*olitical/cultural interoperability* examines why and how each country conducts military operations the way it does.

Interoperability "gaps" between navies may have their roots in more than one of the above types. Additionally, gaps can be based on one type of interoperability and manifest themselves in another. Interoperability gaps that at first may appear to be technical in nature, upon closer examination turn out to have their origin in political/cultural factors.

Ultimately, it is important to remember that seamless interoperability between the U.S. Navy and allied navies is not likely. It is probably an unachievable goal. The United States has designed its armed forces to be able to respond unilaterally

---

4. *A National Security Strategy for a New Century,* White House (December 1999).
5. Quadrennial Defense Review (May 1997).
6 U.S. DoD, DoD Joint Pub 1-02, Department of Defense Dictionary of Military and Associated Terms

anywhere in the world to fight and win major conventional conflicts. By contrast, most U.S. allies tend to be more regionally focused and have smaller-scale ambitions. This smaller scope affects procurement of platforms and systems. Allies need to balance technology to ensure both their national requirements and an ability to operate in coalitions, which will more than likely be led by the United States.[7] This reality probably ensures a minimum level of interoperability. The question is how can allies push beyond this minimum level to ensure the ability to work together across a span of operations.

Interoperability gaps between the U.S. and allied navies

To understand the interoperability gap between the U.S. Navy and allied navies, it is first necessary to compare the U.S. approach to national security with that of our allies. This country's technology-driven culture guides the development of its armed forces and shapes the way it views military operations. At the root of this development is the growing sophistication of the U.S. arsenal and the information technology used to support it. Precision weapons require tremendous amounts of information from multiple sensors. Information is first used to plan missions. Then when the weapon is programed and launched, information must be continuously transmitted at very high rates of speed.

The U.S. has developed systems capable of transmitting data in huge quantities at tremendous speed. As a result of the influence of precision weapons, organizational changes are required in doctrine and tactics, techniques, and procedures (TTP) to most effectively employ their force projection capabilities. In addition, the information capabilities developed for weapons can be used in other unintended ways for command, control, and communications, and so forth. Rules of engagement (ROE) can be more liberal, on the assumption that advanced sensors can provide sufficient information to judge the severity of incoming threats

U.S. allies develop their force structure from a different perspective, one more linked to platform procurement than to technology and systems development. When they decide how to spend ever-declining defense budgets, high-profile items such as frigates and fighter aircraft tend to take precedence over high-technology C4I systems. Many allied navies equate platforms with capabilities. According to one informed source, "C4I is not held in the same reverence by the allies as it is by the United States."[8] As a consequence, the allies do not approach C4I with the same logic and pace of development as the U.S. force.[9]

---

7 Frederic Ruiz-Ramon, "Is There an Interoperability Gap," *Seguridad y Communicaciones,* Volume 11 (May 1999), pp. 73-81.

8 Interview with various U.S. experts on European navies, January 24, 2000.

9 This was made very clear in discussions with allied navy officers and U.S. Navy personnel. Allied navy officers viewed IT-21 as a distant, still evolving concept. While they were not entirely clear on where the allies fit into the IT-21 picture, they believed that its implementation was still far into the future and there would be time for the allies to find their niche. U.S. Navy

Further exacerbating this problem is the fact that U.S. development of military equipment often does not consider allied use of the systems. The result is that U.S. systems are modified to accommodate allied navies after they have already been in use by U.S. forces. For certain types of systems this practice does not create interoperability problems. However, altering highly sophisticated C4I systems for allied use where connectivity is critical may render these systems less interoperable.

This fundamental difference in approach to procurement often leads allies to identify the gap in technology terms, arguing that U.S. technology is fast outpacing their ability to keep up. Some point out that they cannot afford to buy the systems that the U.S. has developed. Those that can buy the systems say they cannot afford the longer-term process of system upgrades. This affordability argument ignores the fact that compatible systems do not necessarily have the same capability. For example, even if U.S. and allied ships have LINK 16, they may not have the same ability to send and receive data. The U.S. military's move toward greater use of modern information systems permits it to send and receive data of various types in much greater volumes and at much greater speeds.

Addressing interoperability gaps between the U.S. and NATO allies

The U.S. must assure allied navies that despite technology differences, the two navies can operate together. If allies were to perceive that a technology gap precluded them from operating with the U.S. Navy in coalitions, the U.S. could find itself incuring greater costs to form coalitions. If the U.S. compensates for different technologies by assigning allied naval forces to specific sectors, for instance, it may have to find ways to compensate coalition partners for asking them to accept visibly inferior positions. If it attempts a more integrated coalition, it risks not being able to fully use its capabilities, particularly its advanced sensor-to-shooter capabilities. This latter cost will be unacceptable to the U.S. because it implies greater risk to its forces---and thus unacceptable political costs in case of casualties because weapons and systems were not used to their full capability.

A more productive way of dealing with interoperability between U.S. and coalition navies is to work toward reaching common agreement as to what missions each navy is likely to perform and where in the coalition it is likely to be situated. NATO interoperability level 5 might be thought of as seamless fusion of various military forces.[10] This implies great demands across all dimensions of interoperability: technical, operational, and political/cultural. However, for future peace enforcement, peacekeeping, noncombatant evacuation operations (NEO), and humanitarian/disaster relief operations, interoperability may be closer to level

personnel, on the other hand, viewed IT-21 and Network Centric Warfare as a fast developing concept of operations that would revolutionize the way the U.S. thinks about warfare. Unless the allies are incorporated into the picture in the near term, they may find themselves unable to operate with the U.S. in the future.

[9] For a discussion of NATO levels of interoperability, see Appendix A.

2(close coordination within a combined joint task force) or even level 1 (basic coordination and communication among participating forces).

Therefore, what is needed is a common understanding between the U.S. and its potential coalition partners that interoperability is not entirely a function of technology, but partly a function of how each country wants to participate in a coalition. Different missions require different types and levels of interoperability. For those allies that want to operate closely with the U.S. in prominent positions, even in high threat environments, the level of interoperability (technical, operational, and political/cultural) will have to be high, possibly bordering on seamless. However, for other allies, the demands of interoperability will be lower.

Elements of interoperability

Interoperability consists of a number of elements including doctrine, tactics, rules of engagement, C4I, and logistics. NATO members have long understood that the ability of armed forces to operate together effectively as part of multinational coalitions requires them to embrace a minimum level of standardization in each of the above interoperability elements. Over the years, NATO has sought to maintain this minimum level through training and through the production and implementation of Allied Publications and Standardization Agreements.[11]

While there is no question that equipment compatibility and robust C4I architectures are critical to coalition interoperability, it should be noted that a high level of connectivity already exists between the U.S. and its key allies. Interoperability in NATO depends largely on standardization. Since its first large-scale maritime exercise in 1952, NATO has worked to encourage standardization. Mechanisms include the Allied Naval Communications Agency, the Military Agency for Standardization, NATO Communications and Information Systems Agency, and the NATO Standardization Group. Out of this bureaucracy have come standards for systems, as well as common procedures and doctrine for using them, if not always common equipment. What is important to remember is that each interoperability element encompasses a host of issues which are important to the success or failure of a coalition operation. It is only once these issues are acco-modated between the various partners in the coalition that the "unexpected can be treated as an everyday occurrence."[12]

Studies at the Center for Naval Analyses have found that most interoperability gaps between the U.S. and its high-end allies are based on the fact that the U.S. Navy often views the difficulties of coalition warfare in technological terms. The U.S. argues that the allies, through spending more or spending the same amount more wisely (as defined by the United States), would be able to bridge the

---

11 The NATO Agreement outlining the mininum level of interoperability is MC-195. U.S. Officers interviwed noted that if a country wants to move beyond the requirements of MC- 195, it needs to "pay attention to trends in the United States."

12 Kenneth Allard, *Command, Control, and the Common Defense* (Washington, DC: National Defense University, 1996), p. 257.

interoperability gap. In reality, the problem is far deeper than anything that could be fixed by spending more money on systems, data networks, precision munitions, or satellites.

For their part, most high-end U.S. allies are committed to NATO structures and procedures ("these guys live NATO") and view coalition warfare as a constant political process that is built on satisfying the members' military requirements through consensus building and negotiation. The political agreements that have been created through years of this process are constantly under pressure from the evolution of technology. The question for the allies is how the alliance process adapts to evolving technology, both in terms of C4I and the other elements of interoperability, while still meeting the domestic and international requirements of the members and maintaining alliance consensus.

Doctrine

A shared doctrine is critical for the success of coalition operations. Doctrine is a description of how a navy intends to operate. Multinational doctrine is a description of how navies intend to operate in a collaborative environment, whether through formal alliances or ad hoc coalitions. In ad hoc situations, harmonizing doctrine between the coalition navies can be challenging because even NATO navies may use different doctrines. This is especially true if one nation uses its own national doctrine centered around nationally mandated missions and concepts of operation.

NATO has achieved a level of standardization in doctrine through years of study, practice, and common experience. Although NATO has not operated with a full set of multinational doctrine as complete and as detailed as the national doctrines that guide the services of the individual countries, it has developed a broad set of publications on procedures and tactics.

Potential disconnects in doctrinal interoperability between the U.S. Navy and its important allies have tended to coalesce around three issues:

- U.S. Navy tendency to use non-NATO tactics and procedures
- Limited allied understanding of evolving U.S. Navy doctrine
- Organizational differences between the U.S. and its allies with regard to jointness

NATO allies closely follow and train almost exclusively within NATO doctrine. The U.S. Navy trains with its own doctrine in unilateral exercises, with NATO doctrine in NATO exercises, and with ad hoc doctrine on a case-by-case basis with non-NATO allies. For the U.S., the optimal level of doctrinal consistency is to move allies toward its own standards. This would allow the U.S. Navy to develop a seamless global fleet rather than an Atlantic fleet more connected to NATO allies and a Pacific fleet more unilateral or connected to Asian allies.

NATO allies would like to see the United States consistently operate within NATO doctrine, increase its training under that doctrine, and use that training whenever NATO navies operate together in NATO or non-NATO situations.

NATO's two operations of the 1990s, a MIO (Maritime Intercept Operation) in the Adriatic from 1992 to 1995, and Allied Force in Kosovo in 1999, have exposed some of the inherent problems. In the Adriatic MIO, the doctrinal implications were minor. An embargo or blockade is a well-understood and time-tested naval operation of navies on both sides of the Atlantic. Carrying out such an operation was within the capabilities of the NATO navies. The clarity of the mission also contributed to the lack of doctrinal questions.

Operation Allied Force, on the other hand, brought out the conflicts between the navies of NATO member states. The U.S. Navy's mission, "projecting power from the sea to the land," was ideally suited to a conflict where the use of ground forces had been set by the political process. For naval operations, the NATO allies, outside of Britain and Canada, were reduced to playing a supporting role. This outcome was the result of two different doctrines. The NATO navies concentrated on supporting ground operations as the heart of naval doctrine (which they have since the Cold War). The U.S. Navy's doctrine of power projection from the sea had driven it to give a large role to TLAMs launched from submarines and carrier-based strike aircraft. These two capabilities were integral to penetrating Serbian defenses under the conditions set by NATO of low casualty and high precision. NATO fleets, with a different doctrine of supporting ground operations or keeping open sea lanes and littorals through ASW or MCM capabilities, were left without a clear mission in the Kosovo operation. If the future of allied operations is to follow the Kosovo model, doctrinal differences will continue to create a gap in the roles and missions of the U.S. Navy and those of its key allies.

If the problem was that simple, allied navies would only need to catch up to the U.S. Navy technologically and adapt their doctrines to project power "from the sea.” The real dilemma is that allied doctrine is preparing for future "Kosovos" while the U.S. Navy is proceeding past Kosovo to "network-centric warfare" and is evolving its doctrine to reflect a changing environment in which decision making is pushed down to the lowest possible level. In other words, the United States is creating a multi-faceted doctrine to deal with the myriad threats that a global superpower might need to confront, while its allies are creating doctrines to deal with specific practical cases in circumscribed areas.

NATO maritime doctrine is concerned with three dimensions: (1) small-scale local conflicts (Kosovo et al.), (2) rogue states with some missile and WMD capabilities on the periphery of Europe, and (3) major regional powers with power projection capacity. Only the United States has developed doctrine to deal with all three of these threats---and in preparing for the higher end of the spectrum, the U.S. has opened a doctrinal gap between itself and the allies. No allied navy has

followed this path for reasons of domestic politics, history, perceptions of threat, national interests, and budgetary constraints.

The doctrine gap has led to technology gaps. To face the spectrum of threats, the global navy of the United States has developed specific technologies for force protection and power projection intended to minimize casualties and maximize punishment. In doing this, it has adopted deterrence and denial strategies that can be used on a global scale: from a small-scale contingency in Kosovo to a major regional conflict in Northeast Asia. To remain interoperable with the U.S. on all levels, allied navies would require a large increase in their budgets. More importantly, they would need to rethink naval doctrine. The very roles and missions of the navy (which drive the force structure and systems that are purchased and maintained) would have to be changed. This would mean changes in the domestic politics and national interest calculations that end up in the elaboration of doctrine.

Technology developments in the United States have been sparked by what is "possible" for a global navy with a large budget for research, development, and acquisition. This has been nurtured in an environment of competitive internal institutions seeking to exert influence on the future direction of the navy. This is in marked contrast to allied navies. To the extent that they desire to cooperate with the U.S. Navy, their doctrine will be hostage to the direction of U.S. Navy doctrine. They can attempt to follow and play niche roles within larger allied concerns by specializing in a particular type of naval warfare, or they can create an extremely small number of ships capable of interoperability with U.S. Navy battle groups. Either way, such national choices limit the roles and missions of their navies and force them to make important decisions about doctrine.

Differences in the level of jointness also have potentially profound implications for interoperability. Since Goldwater-Nichols, jointness has become the bedrock around which the U.S. thinks about future war and the conduct of operations. Preparing for joint operations inspires U.S. doctrinal evolution. The U.S. is moving away from specialized joint warfare, such as that used in Operation Desert Storm, where the coalition carried out multi-service operations in the same battlespace through deconfliction rather than integration. The new U.S. model is JV2010's vision of coherent joint warfare which demands that integrated forces accommodate the natural battle rhythms and cycles of land, sea, and air warfare. In this type of environment, the ability of key allied navies to interoperate with the U.S. Navy could become strained. The level of jointness among key U.S. allies is lower, thus making it more difficult for them to be incorporated into U.S.-led operations. In addition, the joint nature of U.S. operations has implications for other elements of interoperability, such as the ability to communicate. The need for jointness is driving U.S. C4I architectures away from service specific systems toward networked systems that can ensure battlespace dominance. How allied naval operations fit into this architecture has yet to be determined.

Tactics, techniques, and procedures

If the capabilities of a maritime coalition force are to be coordinated in a unified effort, all participants require a common understanding of how to operate together. For the U.S. Navy and many of its key allies, such a common understanding has been based on lessons learned through years of operating together. Although NATO does not have a codified multinational naval doctrine, it has for decades operated from a broad set of publications laying out tactics, techniques, and procedures (TTPs). The primary purpose of these Allied Tactical Publications (ATP) is to facilitate the dissemination of orders and information pertinent to allied maritime operations. They provide an indispensable common source of signals and tactical principles such as: how to deploy an ASW screen, how to conduct rear area support, and how to maneuver in formation. These publications are ever changing tools that require periodic updating.

The advent of ad-hoc coalitions of the willing in the post-Cold War era highlighted the need to create a common base of knowledge. This has been accomplished in part by the release of sanitized versions these NATO ATPs to non-NATO countries participating in exercises or real- world operations. The intent is to create a body of unclassified doctrine and procedures to support maritime operations other than war. Specifically, this series would provide procedural guidance for conducting maneuvers at sea, basic maritime exercises and evolutions, and selected peace support operations. These experimental tactics manuals (EXTACs) are unclassified, require no security protection, and can be released to non-NATO countries independently by member nations.

Rules of engagement

A critical aspect of any military operation, multinational or otherwise, is how to tailor the military force to achieve political objectives. One instrument is national rules of engagement, which are directives issued by a competent national authority that specify the circumstances and limitations under which armed force may use force to accomplish a mission. National authorities use ROE to manage the escalation of tensions and to ensure the proper execution of national policy.[13] Thus, each national force will have its own interpretation of ROE.

Lack of a mutually agreed-upon ROE (or at least a range of acceptability among all the ROEs) presents a major challenge that reaches into all aspects of coalition operations. Even coalition members with similar political mandates may have significant differences in ROE. Differences in ROE can be as important as differences in capability, and may reduce operational effectiveness. If members of a multinational operation cannot agree on comon objectives (political and military), achieving the means to those objectives will be more difficult. Particular interoperability problems with regard to ROE include:

---

13 U.S. Naval Doctrine Command, *Multinational Maritime Operations* (September 1996), 4A1-4A4.

- There may be differences between domestic laws, and between interpretations of international law governing the use of military force.
- Some countries may qualify their ROE geographically.
- A country's national ROE may change with time and/or circumstances.
- Different political objectives among coalition members can lead to disagreements over actions required to achieve objectives.
- Physical capabilities of certain members can limit what they can do and how they do it.

ROE problems will be particularly acute with ad hoc coalitions thrown together quickly to meet particular crises.

Types of ROE problems that face coalitions fall into four main categories: alignment, interpretation, comprehension, and translation. Although the commanders on the scene may agree on an appropriate ROE action, national ROEs may prevent one or more countries from taking part to the level necessary. This misalignment in ROEs could lead to significant delays, especially if command-and-control procedures dictate that a particular commander get approval from the national authority to take action.

Countries also can differ in their interpretation, and hence implementation, of the same ROE. Cultural differences can cause interpretation problems, even when participants use the same language. This could be especially true when the coalition is faced with evidence of "hostile intent."

Comprehension problems can take two forms. First, lack of comprehension as to the content and context of a particular ROE, or specific ROE approach, could lead to tentative implementation and incorrect judgments. Second, a coalition commander may not know how the ROE of various partners differ.

Connected to the comprehension problems are language obstacles. Coalition members may not fully understand the language in which coalition ROE are issued. Language problems are likely to increase in crisis situations, when verbal requests for ROE changes and amendments are common.

Command, control, communications, computers and intelligence (C4I)

Command, control, communications and intelligence (C4I) are fundamental to the success of an operation. The smooth flow of lines of command, combat information, and communications to and from various elements of force becomes more complex in a coalition. Since C3 encompasses a number of functions---many of which have developed over years in distinct military cultures and with specific equipment---communications and combat systems data do not flow easily between different militaries.

Six C3 areas are critical for interoperability between the U.S. Navy and its allies: (1) a command-and-control system, (2) common operational picture, (3) secure voice communications, (4) digital data exchange, (5) approved security devices and approval to release (sanitized) data, and (6) satellite communications (SATCOM) connectivity. This subsection focuses on systems connectivity in the above areas.

Command and control

Much of the discussion surrounding the command-and-control system focuses on tactical data links, or TADILs, which are networks that rapidly exchange track (geospatial location, vector, and speed) and identification data between ships, aircraft, and ground sites. Currently, the U.S. military is in the process of transitioning from Link 11 to Link 16 (or TADIL J). Link 16 provides certain technical and operational improvements to existing tactical data link capabilities. It also makes some other improvements, including: jam resistance; improved security; increased data rate (throughput); increased amounts/granularity of information exchange; reduced data terminal size, which allows it to be installed in fighter and attack aircraft; digitized, jam-resistant, secure voice capability; relative navigation; precise participant location and identification; and increased numbers of participants.

Tactical data links make up one area of C3 that holds out promise for future improvements in interoperability between the U.S. and its key allies. Link 11 is widely distributed throughout the fleets of the U.S. Navy's key allies (especially in NATO) and will continue to be prominent into the near future. Also, interoperability is being built into the U.S. transition to Link 16, which is a Foreign Military Sales item to allied navies. In addition, the U.S. is a member of a five-nation cooperative development effort to develop MIDS (Multifunctional Information Distribution System), a terminal to handle transmission in JTIDS format (the Link 16 format for messages). MIDS terminals will be installed on both ships and tactical aircraft in the navies and air forces of all five participating nations.[14] It should also be noted that a greater than usual amount of engineering

---

14 The five nations are the U.S., France, United Kingdom, Spain, and Italy.

attention is being given to operational specifications and standards for Link 16 and JTIDS formatting.

Some uncertainties, however, surround the tactical data link issue. In the future, there will be a wide mix of data links among the U.S. and high end allies. In addition to Link 11 and Link 16, NATO (including the U.S.) is developing Link 22. This is an effort to improve both Link 11 (HF-capable, therefore long range, but jamming resistant) and Link 16 (limited to line of sight, but jamming resistant). This could lead to a divergence between the U.S. Navy and allied navies for beyond-line-of-sight (BLOS) TADILs, with the U.S. opting for Satellite TADIL J (Link 16) and many of its allies opting for Link 22. This becomes problematic for interoperability if there are continued or unexpected problems with the command-and-control processor, which acts as a translator of data forwarded from Link 11 and Link 22 on the one hand, and Link 16 on the other.

Common operational picture

The U.S. Navy's approach to providing a common operational picture (COP) is tied to the development of the Global Command and Control System--Maritime (GCCS-M). GCCS-M, which will be on all U.S. Navy ships, is an automated information system designed to support deliberate and crisis planning. By displaying inputs from a wide array of sources, GCCS-M provides an operational-level (CJTF-oriented) degree of situational awareness for units and commanders.[15]

Many allies see GCCS-M as a way of improving interoperability with the U.S. Navy. Because the system is intended to be on all U.S. ships, and to serve as the main means of processing and displaying operational data, it has been seen as a key, affordable complement to the tactical data links which many allied navies already possess. In fact, GCCS-M has already been marketed and sold to many allies.[16]

A major problem related to GCCS-M and the development of a common operational picture concerns releasability.[17] This is because the U.S. packs many input sources into the GCCS-M processor and terminal, some of which are not releasable to even the U.S.'s closest allies. In addition, even though NATO has developed its own version of JMCIS, the Maritime Command and Control Infomation System (MCCIS), which is designed to provide a geospatial COP, U.S. national filters prevent the two systems from sharing the same data.

---

15 GCCS-M is supported by JMCIS, which provides afloat, ashore, joint, and allied commanders with a single integrated command, control, and information system that receives, processes, displays, and maintains geolocation on friendly, hostile, and neutral land, sea, and air forces.

16 Canada, Italy, the Netherlands, and Australia have bought GCCS-M. Germany, France, the United Kingdom, and Japan are exploring the option of buying GCCS/JMCIS.

17 The basic releasability of GCCS-M functions varies from country to country, so while the systems are compatible, an FMS does not deliver the identical capability to all customers.

Besides the restrictions on disclosure between the two systems, possible technology gaps could prevent the two systems from sharing information. The rapid pace of development of U.S. GCCS-M has caused concern about the disparity in the evolution between GCCS-M and MCCIS. Recently, representatives of the MCCIS Life Cycle Working Group have urged both SACLANT and SPAWAR to maintain compatibility between the two systems.

There is hope, however, that the gap will not be unmanageable in the future. The plan to harmonize/converge NATO's major commands, SACLANT and SHAPE, may offer some additional rationale for the compatibility argument. There is a fledgling effort to produce a NATO common operating environment (COE). The closer this is to DISA's DII COE, the more likely it is that functional capabilities produced by one system will eventually be able to integrate with the other. This NATO COE will take several years to formulate in principle and then produce in fact. Both SACLANT and SPAWAR have declared that they intend to keep the MCCIS and GCCS-M systems as close as the budget and political processes of the two entities will allow. While the basic interchange of data today is the OTH gold message standard, the intent is that the exchange and technical envelopes of the two systems will continue on a slowly converging path. This in turn should influence the NATO COE and DII COE architectures, laying the foundation for greater interoperability.

In the meantime, the U.S. Navy and its allies will likely resort to workarounds to develop the common operating picture. During JTFEX 99-1, the JMCIS-MCCIS problem was solved by a U.S. willingness to make most, if not all, JMCIS messages releasable to NATO.

Secure voice and video communications

One area where the U.S. Navy is placing great emphasis is on availability of secure voice and video teleconferencing (VTC) throughout the fleet. Both are made possible by the large amount of bandwidth expected to be available to U.S. Navy forces. U.S. advances are expected to result in greatly increased numbers of secure voice channels available to afloat users, and in VTC capabilities for smaller U.S. ships. Major initiatives in this arena involve VTC at 512 kbps for carriers, cruisers, DDGs, LHA, LHD, and LPD amphibs. Secure telephone equipment (STE), using encryption in the form of a Fortezza card, accredited by the NSA, will replace STU-IIIs on U.S. ships.[18]

The current interoperability gap in secure communications is not unmanagable. Most key U.S key allies have STU-II telephone sets, which are interoperable with the U.S. Navy's STU-IIIs.19 But allies are complaining about growing U.S.

18 CNA-hosted C4I conference on allied interoperability, September 23, 1998.

19 Note that it is not clear whether the allies will follow the U.S. lead when the U.S. moves from STU-III to STE. If they do not follow, they could find themselves hampered by a lack of spare parts since Motorola has announced that it is discontinuing the manufacture of STUs.

reliance on video teleconferencing (VTC). For many allies, Kosovo proved that if commanders are dispersed during a U.S.-led operation, VTC will be critical for planning. At present, there is no requirement for release of VTC to NATO. And even if releasability was not an issue, there are serious questions as to whether the allies would have the bandwidth to support VTC.

Digital data exchange

One of the most important C4I interoperability problems in recent operations and exercises has been difficulty in exchanging digital data between computer workstations. Difficulty in connecting U.S. and allied wide-area networks (WANs) is the principal reason.[20]

Chairman of the Joint Chiefs of Staff Gen. Hugh Shelton has noted the importance of developing a coalition wide area network (CWAN) to promote the passing of information between the U.S. and coalition allies. General Shelton has indicated JCS intention to with NATO and the Combined Communications Electronic Board (CCEB) allies to make CWAN a part of the long-term enhancement of C4ISR interoperability[21]

In theory, a CWAN would allow allied militaries to put their information systems together and, therefore, share operational data. Once in place, the CWAN would become the common coalition backbone to provide real-time collaborative planning, interoperability, and connectivity between U.S. and allied forces.

In the past, the U.S. made a point of establishing a coalition network for exercises, such as RIMPAC 97, 98, and the NATO Mediterranean exercise Dynamic Response 98. After these exercises, however, the CWANs were dismantled. As for standing WANs, NATO has developed secret wide area networks to support operations in Bosnia and Kosovo. SFOR operations are supported by the NATO CRONOS WAN, while KFOR operations use the NIDTS architecture.[22] At present, work is being done to harmonize the two WANs into a NATO classified WAN that will support both operations.

Efforts to develop a CWAN, in which U.S. and allied systems would be connected, are being undertaken. In the summer of 1999, the Joint Warrior Interoperability Demonstration (JWID-99) tied the U.S., Australia, Canada, France, New Zealand, Spain, Turkey, and the United Kingdom to the military networks of SHAPE headquarters. This was a departure from past JWIDs in that it was used to evaluate allied systems, not just U.S.-only technology. As a result, U.S. officials have decided to focus on refining and implementing a long-term CWAN for testing purposes. This permanent research forum (a virtual center),

---

20 A WAN is the common information or workstation environment for a group of users.

21 A coalition wide area network was a feature of the Navy's Pacific RIMPAC 2000 exercise and was assessed as very successful.

22 CRONOS stands for Crisis Response Operations in NATO Open Systems. NIDTS stands for NATO Initial Data Transfer System.

which is called the combined federated battle laboratories network (CFBLNet), will be accessible to Australia; New Zealand; Canada; the U.S.; the United Kingdom; and the NATO Consultation, Command and Control Agency nations, including Germany, France, Turkey, and Spain.[23] Over time, it is hoped, this exchange of information between allies will help advance aspects of organization, doctrine, and system interoperability.

Problems that have prevented the development of CWANs to support real-world operations revolve around U.S. restrictions on foreign access to SIPRNET, which is the U.S. Navy's primary secure means for passing on photos and text messages.[24] This has been a major issue among some key U.S. allies and has been raised as one of the most significant challenges to combined interoperability with the U.S. Navy.[25] Since SIPRNET is not able to link into NATO's secure net (NIDTS), U.S. ships have to rely on more traditional radio communications to communicate with allied staffs.[26]

Connectivity between the U.S. and its allies is also hampered by procedural problems. This became very apparent during Dynamic Response 98, which was designed to exercise a U.S. Marine Expeditionary Unit (MEU) in its role as the Strategic Reserve for the NATO Stabilization Force (SFOR) in Bosnia. C4I interoperability had to be established between a U.S. national unit, which was sea-based, and the fairly mature land-based NATO C4I structure of SFOR. The intent was to establish a gateway connection between the NATO CRONOS WAN that served SFOR, the U.S. WAN called LOCE (Link Operations Center Europe), and the U.S. defense satellite communications system (DSCS). Despite much effort, connectivity for the MEU was achieved only intermittently and with difficulty, largely because U.S. naval units were unfamiliar with operating this particular WAN. Since U.S. units were operating U.S.-only systems, it was difficult to establish linkages with allied or NATO systems.[27]

Satellite connectivity

The C3 area that receives a great deal of attention in any discussions of future coalition operations is SATCOM capability. In particular, bandwidth is seen as the key factor that differentiates U.S. capabilities from those of its allies. Over the last decade, the U.S. has dramatically improved its C4I through investments in commercial and military SATCOM, which has enhanced the available bandwidth

---

23 "Allied Force Technology Demonstrations Illustrate Power of Coalition Network," *Signal* (October 1999), p. 37.

24 SIPRNET is the U.S. classified intranet used for e-mail, file transfer, and web browsing and access.

25 The U.K. Royal Navy made this criticism following Operation Desert Thunder in 1998.

26 During JTFEX 99-1, the SIPRNET problem was addressed by locating the allied staffs on board U.S. flagships (*Theodore Roosevelt* and *Kearsage*), which were both able to connect to NIDTS. One U.S. flagship, *Mount Whitney*, because of its NATO role, goes even further. It has both JMCIS and MCCIS, as well as SIPRNET and NIDTS. The JMCIS and MCCIS consoles are positioned alongside each other, and their operators constantly verify that the two systems show a common picture. Likewise, a SIPRNET and a NIDTS terminal are grouped together so that the information on their respective websights can be synchronized.

27 CNA-hosted C4I conference.

to U.S. forces.[28] See table 1 for an explanation of the different types of bandwidth and the advantages and disadvantages of each. As a result of this enhanced bandwidth, the U.S. has a greater capacity and flexibility than its allies to conduct planning, transfer data, and carry out a wide variety of operations.[29] By all indications, the gap in SATCOM capability will continue to grow at least in the near future.[30]

Table 1. Satellite bandwidths and their advantages and disadvantages

Bandwidth	Frequency	Advantages	Disadvantages
UHF	.3 to 3 GHz	UHF, which incorporates B/C band (formerly L band) and E/F band (S band), offers terminals that are operable in adverse weather conditions and is highly suited for mobile operations. It primarily supports a single channel per carrier and demand-assignment-multiple-access (DAMA).	Heavily congested and highly suscep tible to jamming.
SHF	3 to 30 GHz	SHF has the wide operating bandwidth needed to support high data rates, while its relatively high frequencies provide narrow antenna beams, which in turn make multi-beam and spot antennas practical. It also provides resis tance to jamming and is relatively immune to all but the most severe weather. SHF is largely used for frequency division multiple access (FDMA) and DAMA services.	
EHF	30 to 300 GHz	EHF is the most survivable and secure band of the three and provides users with good anti- jamming and anti-scintillation characteristics. It also has a low probability of detection/intercep tion. Primarily used for Time Division Multiple Access (TDMA) services, it can support low and medium data rates and has the potential to pro vide high data rates.	The terminals are expensive, and the service can be degraded by heavy rain, snow, hail, and other weather conditions.

Allied investment in SATCOM is expected to increase in the future. But despite this investment, there is good reason to believe that allied navies will remain severely constrained in their ability to take advantage of the full range of SATCOM capabilities. At the organizational level, NATO will be hard pressed to reach a consensus on the communication requirements for out-of-area operations

28 The United States' heavy investment in SATCOM is driven by the fact that today's sensors and weaponry require transmission of ever growing amounts of data. Satellite communications are the only way of achieving this over very long ranges.

29 During Desert Storm, only a few U.S. ships had SHF SATCOM capability, operating at data rates of about 19 kbps. By contrast, during Desert Thunder (1998), several U.S. ships had data rates that were multiples of T1 (1.522 mbps) capability. Allied ships in 1998 at best operated at data rates of 64 kbps.

30 U.S. investments in SATCOM will not only yield an increase in bandwidth available for ship-to-shore communications, but also mean a significant increase in the flexibility between different types of SATCOM media. This will mean that U.S. naval commanders will be able to exploit the agility of the SATCOM system to ensure information exchange to a wide variety of units. U.S. Navy plans for SATCOM investment include a concept to develop a basic minimum level of bandwidth for smaller ships such as cruisers, destroyers, frigates, and SSNs. This "IT-21 capability" is currently set at 128 kbps. This will allow U.S. ships to receive a common tactical picture based on Link 16, and a common operational picture based on GCCS, e-mail, and receipt of indications and warning (I&W) data from selected national sensors.

other than Bosnia, Kosovo, and the surrounding region. The aging NATO IVA and IVB satellites have forced NATO to think about SATCOM requirements.[31] But, according to informed sources, NATO's SATCOM plans will likely understate the requirement for commercial SATCOM and the requirement for mobile SATCOM to and from ships.[32] In addition, investment in ground stations is unlikely to be significant.

From the national perspective, several countries have made a commitment to develop or upgrade existing SATCOM systems. By 2005, the number of satellites controlled by allies will increase. Most will be commercial satellites based on commercial-off-the-shelf (COTS) technology. The technologies involved and currently in development, combined with the numbers of satellites expected to be placed in GEO, MEO, and LEO orbits, will permit high-end allies to increase their SATCOM capabilities.

During Desert Storm and more recently in Kosovo, the allies came face to face with their near total dependence on U.S. intelligence---especially geospatial intelligence, such as imagery---for their operations. This ignited interest within several countries to avoid such a situation in the future. The allies also realized the power and advantages of the U.S. preponderance in information collection resources, as well as the importance this vast array of resources played in managing a coalition operation.

SATCOM, however, competes with other very high priority demands on significantly decreased allied defense budgets. This raises the question, "How much SATCOM capability is enough to address national (and coalition) requirements?" The answer varies by country, depending on national defense strategies and views of possible threats and interests. Therefore, in future coalition operations, allies may provide SATCOM coverage in different degrees, varying by area of operation.[33]

Another question facing the allies is how to maintain SATCOM interoperability with the U.S. for out-of-area operations. Nationally owned or NATO satellites most likely will be unable to meet this challenge entirely. Therefore, many allies have become resigned to the fact that in a crisis, the U.S. will fill unmet requirements.[34] Some countries have attempted to ensure their access to U.S. military satellites by trying to negotiate memorandums of understanding that will allow them to rent space. Because allocation of U.S. SATCOM is a CINC and JCS responsibility, there is no guarantee that this will be possible. In a crisis,

---

31 NATO's IVA and IVB satellites are expected to be retired in 2003 or 2004.

32 The official NATO requirement for naval mobile SATCOM is unlikely to exceed 64 kbps in 2005.

33 France, for example, can be expected to have nearly 100 percent SATCOM coverage over Northern Africa and the Middle East, two areas critical to its defense strategy.

34 As defense budgets among the allies have declined and the possibility of fielding national satellites has become more challenging, this belief in U.S. “final hour generosity” has in many cases worked against individual initiatives to invest in SATCOM as a priority.

SATCOM availability is allocated on a needs basis, beginning with the needs of U.S. forces.

Despite rhetoric to the contrary, key allies will continue to rely on U.S. SATCOM. At best, investment in SATCOM will aim to fulfil national and regional requirements. Some low-cost solutions, such as UAVs, may also reduce dependence on the U.S. during operations. But, ultimately, in view of declining defense budgets, a major allied shift away from SATCOM is not expected.

Intelligence

One of the key ingredients to ensuring the cohesiveness of a coalition is the sharing of intelligence. Intelligence is critical to the creation of a common operational picture from which commanders learn about events and activities outside the coalition that may affect the force's capabilities, missions, or well being. Timely and accurate intelligence is necessary to provide a unified picture of threats, hostile intent, or damage assessment, or a unified overview of a humanitarian situation.[35] And in the coming era of diverse threats, it is most likely that no nation in the coalition will possess the best intelligence in all categories. Therefore, all nations involved may have valuable contributions to make to the overall intelligence picture.

Releasibility is the biggest problem. Coalitions, even those based on existing alliances, are likely to consist of countries that use information in different ways and may have restrictions on its dissemination. Therefore, interoperability requires procedures, software, and devices to allow screening and transfer of information that is releasable, without putting restricted information at risk. The various means of making this happen are grouped under the terms “multilevel security” (MLS). According to the DISA definition:

> MLS is a capability that allows information with different sensitivities (i.e., classification and compartments) to be simultaneously stored and processed in an information system with users having different security clearances, authorizations, and needs to know, while preventing users from accessing information for which they are not cleared, do not have authorization, or do not have the need to know. MLS capabilities often can help overcome the operational constraints imposed by system-high operations and can foster more effective operations.[36]

Because MLS during a crisis is such a manpower-intensive operation, this is one area where the U.S. and its allies are looking to technology as a possible solution. But because of cryptology-related constraints, many sound techonological solutions could founder. In addition, in a crisis or contingency context in which the U.S. has the overwhelming advantage in intelligence, it will be politically and

35 U.S. Naval Doctrine Command, *Multinational Maritime Operations* (September 1996), 4-4.

36 DoD MLS Homepage, Multilevel Security in the Department of Defense, Basics, Unclassified, undated.

militarily risky to relegate information flow to allied commands and forces via fully automated means.[37]

Assuming that the U.S. will frequently lead and manage the naval coalitions in which it participates, its challenge of forming and maintaining a coalition in a crisis situation will be even greater when dealing with multiple, stratified levels of national intelligence capability and multiple levels of authorized intelligence access within a coalition. Specifically, with multiple levels of capability and disclosure, the information flow for each nation or tier of nations will be different. Maintaining the coherence of the coalition under these conditions will be difficult. The U.S. will probably pay a premium in terms of manpower and required attention to workload to keep track of the flow of U.S.-originated or ally-originated information among the members of the coalition. Thus, ensuring that the tasking and positioning of allied units relative to U.S. units is commensurate with their information flow is likely to remain a major challenge for U.S. commands.

Another problem relating to disclosure concerns the classification of information. There is an inconsistency and lack of uniformity within the U.S. government on security labeling of information in electronic form. No standards have been applied to information residing in automated information systems. As a result, information of lower classification level is trapped in system-high networks. Until labelling problems are resolved, little progress can be made with regard to the ongoing multi-level security effort. Some argue that the "Top Secret" classification needs to be redefined in order to ease the flow of information to the allies.[38]

It should be pointed out that the disclosure problem is not confined to the United States. Discussions of the deployment of a NATO WAN by 2005 raise issues among allies about the security provided by MLS and firewalls. National disclosure guidelines reside at the national level and are often above the authority of the National Component Commander (NCC). Therefore, national security protocols could inhibit the exchange of information needed to provide the coalition with a common operating picture. In addition, navies vary in terms of how they operate and how they do command and control. Many key U.S. allies have concerns about automated MLS. They have traditionally operated with closed systems. In many respects, this is a problem with cultural roots that leads many potential coalition partners to be wary about networks and automated security

37 While most agree that the disclosure issue is critical to the ability of the U.S. to interoperate with the allies, there is disagreement as to whether it is always a limitation. Some note that CINCs determine the operational requirements for interoperability. This directly (or indirectly) impinges on the level of disclosure. Therefore, it is not a problem---or if it is, it can be managed. Others argue that in a high threat environment, where systems are required to share information in real-time, U.S. disclosure rules could be a significant, and potentially lethal, limitation.

38 CNA-hosted C4I conference.

("fear of the Internet").[39] This could lead to a gap on the disclosure issue, especially as the U.S. moves closer to IT-21.

If automated MLS is not the complete answer to the disclosure issue, progress on problems relating to releasability will probably be made as various countries grapple with the information age. Military organizations and governments may have to become less risk averse and accept the fact that some information may slip through to non-authorized parties. While in the past, national closed-loop systems avoided risk, evolving concepts of operation may force systems to manage risk.40

Logisitics

A requirement for effective coalition operations is standardization of logistics, including doctrine, operating procedures, terminology and definitions, and support systems.[41] Logistics determine a force's capacity to sustain operations and can be critical in determining its feasibility, composition, and outcome.

NATO navies have operated together for decades using principles of NATO logistics. The most important principle is that the "responsibility for logistic support to national component forces will, in general, remain with the responsible authorities of the nations concerned.[42] The alliance's *Logisitics Handbook* states as a further principle that NATO forces should attain standardization of material and services and that when this standardization cannot be obtained, they must at least achieve interoperability. These principles, and 40 years of working together, have prepared all NATO members to coordinate and cooperate in matters of logistical support even if not operating under the alliance umbrella.

Operations in the post-Cold War era have highlighted certain logistical strengths within the alliance. The allies have standardized refueling systems and procedures to facilitate mutual resupply and replenishment on land and at sea. They have ensured that ships of any member nation can use the port facilities of any other nation. They have built a framework for the further development of interoperable logisitics among members in future operations. The agenda for the future of interoperability concerns for NATO members includes:

- Identifying supplies and services that are sufficiently common that they might be provided to all forces by one nation or a multinational organization
- Deciding if, when, and how transfer authority over national logistics assets will be provided to the coalition commander

---

39 MLS, for example, is a major issue with France, which has tended to move significantly more slowly than the U.S. in terms of net-based systems. Cultural sensitivities with regard to disclosure have kept the French from moving quickly into the internet and e-mail. This seems ironic, given France's desire to play a major role in C4I issues.

40 CNA-hosted C4I conference.

41 U.S. Naval Doctrine Command, *Multinational Maritime Operations* (September 1996), pp. 6-1-6-5.

42 *NATO Logistics Handbook* (Brussels: Senior NATO Logisiticians' Conference Secretariat, November 1989), p. 26.

- Developing an agreed-upon mechanism and procedures to account for and reimburse nations for services and supplies exchanged between nations

- Establishing responsibility for, and procedures to obtain, release of national assets to other nations' forces

- Maintaining national asset visibility (from the national sustaining base to the forward units at sea)

- Ensuring compatibility of communications between national logistics organizations of the coalition and national support systems.[43]

NATO's progress on these issues has been dramatic and is reinforced within the CJTF concept. These have been the general priorities for new members, with specific attention to the naval role in Poland and the air role in Hungary and the Czech Republic. This underscores the importance of logistics interoperability to NATO members.

Interoperability by warfare area

We now turn our attention to an examination of interoperability across seven distinct warfare areas. The warfare areas that we will address are: anti-air warfare (AAW), surface warfare (SUW), undersea warfare (USW), anti-submarine warfare (ASW), and mine warfare (MCM. In each warfare area we examine the capabilities of the U.S. Navy and key allied navies, interoperability gaps, future trends, and potential future interoperability gaps.[44]

Coalition operations often require navies to work together in several warfare areas at once. Differences in U.S. and allied naval platform capabilities and employment across warfare areas can result in different degrees of interoperability within one combined operation.[45]

Anti-Air Warfare

AAW operations require rapid dissemination of tactical information because the time between identification and engagement of hostile air assets may be minimal. The U.S. Navy relies on a network of sensors, communications systems, and weapons systems to conduct AAW operations. Aegis cruisers and destroyers are the primary AAW assets in the U.S. fleet. U.S. C4I architecture creates a tactical picture that can be shared by most U.S. Navy platforms. However, it cannot be shared directly with other navies. U.S. commanders have found ways to bridge or work around this technical gap. The U.S. Navy relies heavily on voice communications to relay important aspects of the tactical picture. Because allied navies at a minimum have voice communications with the U.S. Navy, it is

---

43 U.S. Naval Doctrine Command, *Multinational Maritime Operations*, op. cit.

44 These are not the only warfare areas where interoperability is important.

45 There may, for example, be a high degree of interoperability in ASW and a lower level in SUW.

possible to operate together without technical parity existing across the coalition. However, relying solely on voice communications is inadequate in a hostile environment due to the compressed time-lines of AAW.

AAW interoperability gaps

Interoperability gaps between the U.S. and many of its key allies in AAW concern ROE and C4I, specifically in command and control. Common ROE among coalition navies do not necessarily ensure effective target engagement by allied forces. The U.S. Navy's enthusiastic embrace of the notion of "hostile intent" versus the more cautious "immient threat" is well suited to the rapid pace of AAW operations. Many within the U.S. Navy have voiced concern that because of potential constraints or lack of technical integration into the AAW bubble, allied navies may adopt a more cautious ROE during an operation when it comes time to shoot.

Despite likely interoperability in tactical data links, the U.S. and most of its key allies have limited Joint Planning Network (JPN) interoperability. This lack of interoperability could impair the ability of allied commanders to coordinate units. Information passed via Joint Data Networks (JDN), including tactical data links, is likely to be complemented by information passed via JPNs. For example, collaborative Air Tasking Order (ATO) planning will likely be done using JPNs, while ATO execution will use JDNs. In addition, many allied navy units do not have the C4I equipment to receive the ATO once it is created.

Sensor-to-shooter network interoperability is another problem likely to limit many navies from being able to play a major role in coordinated air defense. The U.S. Navy is currently testing the Cooperative Engagement Capability (CEC) system that integrates the sensor data of each ship and aircraft into a single, real-time, fire-control quality composite track picture. CEC is designed to allow greater engagement range of enemy forces and missiles, and to allow the integration of battle groups or joint task forces into single units. While many nations have expressed an interest in procuring CEC, it has not been released for foreign distribution. Therefore, in the near term, without a sensor-to-shooter network, allied ships would conduct AAW operations as stand-alone systems, unlike U.S. units that will act as part of a network.

TBMD

Sea-based TBMD is another area with potential interoperability gaps between the U.S. and its allies in the near future. While the U.S. and many of its allies are developing sea-based TBMD systems, the pace of development varies. The U.S. Navy is in the process of acquiring TBMD capabilities. The Navy Area TBMD system provides for a point-defense beginning in 2003. By 2005, the Navy plans to equip 21 Aegis cruisers and destroyers with Area TBMD.

A critical question facing the U.S.' allies is how to integrate their surface forces into the "coalition bubble" and be able to support TBMD operations. Many navies point to CEC as critical for interoperability with the U.S. Navy in TBMD missions. But it is important to note that CEC is a line-of-sight (LOS) system, which will not address operations beyond-the-line-of-sight (BLOS). Optimally, this is solved through Link 16 SATCOM, which is part of the near term procurement plans for many nations.[46] Additionally, CEC is not a requirement to use U.S. sea-based TBMD systems; it simply enhances capability.

Table 2: Emerging TBMD systems for non-U.S. ships

Equipment & TBMD capability	TFC (Germany, Netherlands)	CNGF (France, Italy)	CNGF(UK)	F100(Spain)
Launcher	MK 41	SYLVER	SYLVER	MK 41
Radars	APAR, SMART-L	EMPAR S-1850-M	SAMPSON S-1850-M	SPY-1D
Missiles	ESSM SM-2Blk IIIA SM-2 Blk IVA SM-3	ASTER-15 ASTER-30	ASTER-15 ASTER-30	ESSM SM-2 Blk IIIA SM-2 Blk IVA SM-3
Lower Tier Capability	FEASIBLE Dependent on Modifications	FEASIBLE Not a PAAMS requirement	FEASIBLE Not a PAAMS requirement	FEASIBLE Assumes pro-curement of SM-2 Blk IVA
Upper Tier Capability	Requires interceptor. Requires sensor and software mods.	Requires developmentand major mods.	Requires development andmajor mods.	Depending on study results and funding required.

TBMD intelligence requirements are another area of potential intelligence gaps between the U.S. and its allies. TBMD missions require: real-time intelligence such as missile launch and impact point information, near-real-time intelligence

46 Some allied navy officers have noted the possibility of working around the Link 16 SATCOM issue by relying on a ship-shore-ship-buffer (SSSB). SSSBs are fixed sights on the NATO littoral which provide communications and translation of Link 11A to either Link 1 or Link 11B. This enables naval vessels to pass air track information to the air defense system. SSSB would have to be modified to accept Link 16 to allow it to provide tactical data link exchange of TBMD command and control information.

such as re- supply sites, and non-real-time intelligence such as enemy order of battle. Such information is currently available through national sensors and national intelligence systems. Passage of much of this information will depend on wide-area networks such as Linked Operations Intelligence Centers Europe (LOCE). Many nations have concerns about passing information over the internet, which could create interoperability problems in intelligence sharing.

One of the major gaps between the current U.S. and many of its key allies revolves around the navy's role in TBMD. U.S. Navy TBMD is only part of an integrated land, sea, and air capability that supports a three- pronged strategy of active defense, passive defense, and counterforce. In other words, it is a joint approach supported by a ballistic missile C4I architecture (BMC4I). The relative lack of jointness among many of the U.S.' allies has led to a less than full appreciation of how ship to shore architectures will be developed at the upper tier between THAAD and NTW.

Surface Warfare

The U.S. Navy approaches SUW from a variety of angles. Carrier battle groups are often the show of force used during crisis- response operations. These battle groups have tactical air, deep land-strike weapons, nuclear submarines, and Aegis cruisers and destroyers. Allied navies, by virtue of smaller force structures are not as diverse in their approach to SUW. But, at the same time, many navies have significant assets to support operations in this arena. For example, the French Navy will soon be putting a nuclear carrier, *Charles de Gaulle*, into service with an air wing consisting of Rafael fighter aircraft and E-2Cs, which will provide limited over-the-horizon targeting. In addition, most French survace and submarine units carry anti-ship missiles, such as the Exocet.

U.S. Navy C4I capabilities are able to overcome many of the obstacles to SUW. Such obstacles include: foul weather, 24-hour surveillance and targeting coverage; integration of surveillance information for targeting; continuous reliable communications with submerged submarines; Electronic Support Measures (ESM) and Electronic Countermeasures (ECM) ability; voice and data links with allied SUW assets; interchangeable ammunition, particularly surface- to-surface missiles; and effective weapons to sensors to counter small, rapid surface vessels. For some navies, modest C4I capabilities and a concept of operation that eschews unit-to-unit coordiation, make it much more difficult to overcome the above obstacles and contribute to more demanding SUW operations, such as power projection and interdiction of enemy SLOCs.[47]

---

47 Power projection here would mean some form of land attack capability.

SUW interoperability gaps

Unlike AAW, U.S. Navy interoperability with even its most technilogically and capability challenged allies can be maintained at a moderate level.48 Technical and doctrinal differences tend to be minimized by the relatively high degree of operational interoperability among surface forces. Past combined exercises (such as El Morro Castle and BALTOPS) and operations (e.g,. Persian Gulf, Somalia, Kosovo) show that as long as there are effective voice communications, U.S. ships will be able to share critical pieces of tactical information with coalition partners. SUW technical interoperability gaps can be worked around by using voice communications.

Future of SUW

The U.S. Navy between now and 2005 will emphasize land strike capabilities in its SUW plans. The USN's enhanced land-attack capabilities will include new missiles and shipboard combat systems in addition to more capable guns. The Land Attack Standard Missile (LASM), due to enter service aboard DDG 51 destroyers and retrofitted cruisers in 2003, will complement ERGM. LASM has a maximum range of 150nm, with a time of flight to this distance of 10min, and an accuracy of 10-20m CEP conferred by the use of INS/GPS guidance. The Advanced Land Attack Missile (ALAM), scheduled to become operational in 2009, will have a range of 200-300nm. This will allow the DD 21 to engage targets out to beyond the maximum distance that can be achieved with the AGS. Potential payloads include anti-armor, submunition and advanced unitary warheads. Tactical Tomahawk (TacTom), due to enter service in 2003, will have a range of 1,600nm (compared with 900nm for the current Tomahawk Land Attack Missile).

One of the lessons to emerge from Operation Desert Storm was the effectiveness of sea-based strike assets. This led may of the U.S.' high end allies to embark on procurement of assets and doctrinal reforms necessary to give their navies a strike capability. France and the UK have tied a land attack capability to their ability to do force projection. Recognizing the limited ability of standard 4.5 inch Mk8 gun, present on most of their key surface ships, to project power ashore, the Royal Navy in the late 1990s began deployment of TLAMs on its SSNs. Both the UK and France have worked together to develop a land-attack cruise missile, the SCALP, which will be carried by aircraft, surface ships, and submarines.

The interoperability questions surrounding strike warfare, as opposed to purely SUW, are complicated and are often closely tied to issues of command and control. The operation in Kosovo highlighted problems in decisionmaking coordination related to the Air Tasking Order. Most of the disagreements revolved around the target development phase of the ATO planning cycle. For some countries one intelligence source was enough to designate a target, for

48 This assessment has been generally supported by interviews of both U.S. and allied naval officers.

others, numerous sources were required.[49] The ability of allies to make significant contributions to the battle damage assessment portion of the ATO planning cycle has led many U.S.' allies to seek independent reconnaissance capabilities, such as dedicated military satellites and UAVs.

The Kosovo crisis demonstrated the acceleration in the pace of operations and maneuver, together with the desire for "real time" control expressed by the higher political-military echelons. The sensor-to-shooter concept reduced the period between the acquisition of information and the treatment of targets to less than one hour. This possible disconnect is magnified when the use of cruise missiles in a coalition operation is considered. Assets such as TLAM are national assets that remain under national control throughout the mission. Coordination among those nations that possess these assets is done through the TLAM strike planning cycle, which is separate but deconflicted with the ATO planning cycle. While there were few instances of coordination problems between the U.S. and UK during Kosovo, as more countries deploy cruise missiles, complications could arise relating to the designation of strike objectives and targets. In terms of the cohesiveness of the entire coalition, the centralized planning between the U.S. and UK during Kosovo through the TLAM strike planning cycle raised issues with other countries since this process existed outside of the regular ATO planning cycle. France, in its lessons learned from the conflict, highlighted the potential for devisiveness within future coalitions since "nations without cruise missiles may find themselves excluded from those aspects of the decisionmaking cycle relating to strikes."[50]

Undersea Warfare

Most of the U.S.' high end allies have rich and proud traditions in the area of USW. Both the French and UK navies deploy SSNs, with the former also deploying highly capable SSKs. Germany's highly skilled conventional submarine force has been a element in NATO planning for decades. Many of the conventional submarines operated by these and other high end allies have, or will soon have, advanced air-independent propulsion systems, which will allow them to operate for three weeks without surfacing.51 Numerous discussions with U.S. Navy submariners have highlighted the respect for foreign submarine capabilites and their vital contribution to coalition operations and training for the U.S. Navy.

The U.S. operational submarine force, by contrast to most of its allies, is entirely nuclear. It is suited to extended submersion and open ocean operations. As a consequence, the U.S. has focused on certain technologies and developed certain preferences that are out of step with many of its allied submarine forces. Many allied submarines use HF communications and do not have the hardware for SATCOM, which U.S. submarines do. It is possible for the U.S. subs to switch to

---

[50] French Ministry of Defense, *Lessons from Kosovo: Analyses and References* (November 1999), p. 19.

51 See *Jane's All the World's Ships, 1998-99* and *Combat Fleets of the World: 1998- 99*.

HF as a work-around for communications over longer distances than underwater phones allow. However, U.S. submariners prefer not to use HF, because it is very directional (traceable). U.S. submarines have advanced sensors and processing gear that allied submarines do not have, and are unlikely to obtain. In addition, the U.S. Navy is unlikely, for national security reasons, to transfer USW technology. Despite these gaps, interoperability in terms of concepts of operation and water space management between U.S. and allied submarines has tended to be high, considering the independing natures of the submarine force.

USW interoperability gaps

By their nature, USW operations do not require constant communications. Seamless C4I interoperability is less critical in USW than in other warfare areas. There is little data to be exchanged beyond contact, heading, and speed. This information can be shared effectively with voice communications. To communicate critical information to other naval forces in coalition operations, submarine commanders need little more than encrypted voice communication gear, a common language, and common publications. For USW, the basic ULF, Teletype, and underwater phone communications technology is the same for all NATO navies.

In USW there are tactical differences between the U.S. and allied navies, but these differences generally do not cause interoperability problems. Most high end U.S. allies uses NATO tactics for USW operations, while U.S. submarines employ national tactics. Many USW tactical differences between the navies can be solved prior to an operation. For example, there may be doctrinal differences between U.S. and allied submarine forces over such matters as safety rules, waterspace management, rules for expending ASW weapons, and coordination between submarines and other naval assets. If both sets of tactics produce effective operations, it is simply a matter of choosing between them. As long as the navies understand which standards will be used and who sets the parameters, tactical differences are unlikely to have a significant impact on operations.

Overall, the level of U.S.-allied navy interoperability in USW is high. Allied submarines can be counted on to provide mutual reinforcement in support of a common mission using comparable tactics and ROE. Due to the nature of USW, greater interoperability is unlikely to significantly enhance operations.

Future of USW

In the near future, the U.S. Navy will prioritize the mission of pursuing diesel subs in the littorals. The U.S. Navy will also be acquiring two new classes of submarines into the fleet: Seawolf and Virginia class. The arrival of these platforms in the fleet will not prompt any marked shift in tactics or missions. These new platforms will have greater capabilities and stealth. The U.S. Navy will also field new USW technologies focused on littoral operations, such as the

Advanced Deployable System (ADS) for shallow-water surveillance. In addition, it will also intensify the offensive and defensive mining operations capabilities of its submarine force. In 2005, the U.S. Navy will introduce the Improved Submarine-Launched Mobile Mine (ISLMM).

For many allies, modernization and force reductions will mean new submarines, but enhanced USW capabilities spread across fewer platforms. This may lead to changes in doctrine or tactics, which may have an impact on the level of USW interoperability between the U.S. Navy and allied navies, but these changes are unlikely to create insurmountable gaps.

Anti-submarine Warfare

Like the U.S. Navy, many allied navies have a variety of assets, such as submarines, MPAs, helicopters, and surface vessels, that can be used for ASW operations. The UK Navy, for example, has the capability of forming two ASW Task Groups centered around STOVL carriers (carrying Sea King helicopters with Stingray ASW torpedoes), ASW frigates (equipped with Lynx helicopters), and SSNs, which are able to closely operate with U.S. carrier battle groups. Most German Navy surface combatants have an organic ASW capability, highlighed by its four F-123 ASW frigates. In the Pacific theater, the Japanese Maritime Self Defense Force (JMSDF) fields a P-3C fleet that is newer and larger than the current U.S. fleet deployed in the Western Pacific. The navy's four DDHs (one per flotilla) provide platforms for SH-60J helicopters.

The problem for many allied navies is growing obsolescence of platforms and systems devoted to ASW, as well as the reluctance on the part of some navies to shift their primary ASW focus, in terms of doctrine and training, from deep water to the littoral. Without the Soviet submarine threat, many NATO navies have downgraded ASW in terms of procurement. This reinforces the view in the minds of many navy leaderships that their ASW capabilities are to be seen as complementary to those of U.S. Navy capabilities. As the German navy chief of staff stated, "the U.S. Navy-German Navy ASW relationship serves as Germany's "technological umbilical cord."[52]

52VADM Hans Lussow, German Navy, "German Navy Profile, *Naval Forces* (6/98), p. 50, 52.

ASW interoperability gaps

Releasability is an impediment to closer interoperability between the U.S. and many allied navies in ASW. There are three basic components of ASW equipment: hardware, processing, and display. In the next five years there are unlikely to be any significant hardware improvements. Most developments will be in the processing units and displays. For security reasons, NATO allies do not always get the most advanced U.S. ASW equipment and technology. Thus, they often develop their own equipment independently for completing the same tasks.

ROE interoperability in ASW is rarely a problem for coalition operations. ROE for U.S. ASW operators is similar to NATO standards, so it is not a significant change for commanders to adopt NATO standards when operating with most allied navies. ROE can be harmonized between the U.S. and an allied navy more easily in ASW and USW than in other warfare areas since those ROE tend to be rather simple. "Hostile intent," for example is difficult to define from the actions of submarines. Thus ASW ROE are written to avoid that insurmountable ambiguity. There are virtually no non-military submarines, and there are few contacts at all in most ASW operations; in practice all submarine contacts can be classified as either friendly, neutral or hostile, thus simplifying ROE. In most cases, for the type of operations submarines undertake, ROE between the U.S. and allied navies are not a significant area of friction.

Overall, interoperability between the U.S. Navy and its allies in antisubmarine warfare is somewhat low. The source of the interoperability gap in this warfare area is technological. The U.S. Navy and many of its allies have different types of ASW platforms, limited communications capabilities, and different sensors and processors. Because the U.S. Navy, for security reasons, rarely releases its ASW technology, a technological gap will likely remain even if there is a further harmonization of C4I systems.

Future of ASW

Traditionally, ASW has been a major challenge, even for the high end NATO navies. The ability to detect, classify, localize, and then either track or attack, depending on the ROE, has proven difficult against modern SSKs in shallow and littoral waters. For the coming five years, the U.S. Navy is concentrating on new drones and helicopter based ASW capabilities, and has no plans for additional MPA when the service life of current platforms expire. In the same time frame, several allied navies are hoping to improve improve their ASW capabilities primarily through the introduction of new platforms and systems.[53] Although the UK will be reducing its SSN force over the next decade, upgrades will be made to

53 One former U.S. Navy officer pointed out that it would be in the U.S. interest to encourage allied ASW development because of the complementary support it could provide during NATO Marine Expeditionary Unit (MEU) operations. In a littoral scenario, the MEU, with its CVs and amphibious ships, would have little room to maneuver. Furthermore, because NATO coalition operations tend to be highly focused, enemy submarines may be able to penetrate key operating areas with little difficulty. The more forces that can be dedicated to providing ASW support to the MEU the better.

this force, especially the Astute class SSN. In addition, an upgrade in ASW helipcopters, the Merlin class, should be deployed into an ASW squadron early in the 21st century. Along with the shift to newer submarines, and F 123s, the German Navy is upgrading its airborne ASW capabilities. It is replacing its Sea King Mk 41s with 38 NH-90 multi-purpose helicopters. Germany's 14 maritime patrol aircraft and four signal-intelligence aircraft will receive service life extensions to keep them flying until an MPA replacement program begins in 2007. Even so, Germany's airborne ASW capabilities will remain roughly the same through 2005. In the Pacific, the proposed development of a DLH that could carry up to ten helicopters would give the JMSDF an even greater capacity for area-wide ASW search.

The addition of new ASW platforms by the U.S. and its allies may have an effect on the level of interoperability in ASW. New tactics required by new allied submarines and upgraded C4I capabilities will likely ameliorate some technological interoperability problems. The most promising avenue for increasing interoperability between the U.S. and allied navies in ASW is in operational interoperability. The U.S. Navy already conducts frequent ASW exercises with its close allies, such as the Veritas exercise between the U.S. and German navies.

Mine Warfare

The U.S. Navy and its allies are going in different directions with regard to mine warfare. Today, the U.S. Navy has relatively few dedicated MCM assets: 10 Avenger-class, and 2 Osprey-class ships in the active fleet, and 2 squadrons of MH-53E helicopters.[54] These numbers are likely to continue to drop as the U.S. Navy moves toward incorporating organic MCM capabilities on many of its major platforms. Many allied navies, contrarily, pride themselves on their expertise in mine warfare. In the European theater, France, the UK, and Germany boast very capable MCM assets that could provide complementarity to a U.S.-led coalition.

In addition to the fact that it is a pioneer in many minehunting techniques, France has designed the most numerous class of modern Western MHCs (Tripartite) and the most widely deployed remotely operated vehicle, the PAP-104. The French MCM force revolves around 13 Eridan class Tripartite minehunters. The German MCM force may be the most capable in Europe. During the Cold War, it was responsible for keeping the Danish Straits open for resupply of NATO allies in a war with the Soviet Union. The German Navy believed that this mission would demand a high degree of mine countermeasures (MCM) capability, and thus they expended considerable resources developing a large and capable mine warfare force. Currently, the German Navy's inventory includes 16 minehunters, 16 coastal minesweepers, 5 inshore minesweepers, and 18 minesweeping drones, as

54 See Jane's All the World's Ships, 1998-99 and Combat Fleets of the World: 1998- 99. See also International Institute of Strategic Studies, The Military Balance, 1996-1997, p. 25.

well as naval minesweeping helicopters. Finally, the Royal Navy boasts one of the most modern MCM fleets in the world even though the number of assets dedicated to this mission is declining. Currently, the UK has approximately 34 MCM ships, of which about half are operational.

MCM interoperability gaps

Differences in platforms and in the numbers of assets contribute to differences in mine warfare doctrine and tactics between the U.S. and allied navies. For its part, U.S. Navy mine warfare doctrine gives highest priority to operations that clear strategic sea lanes, ports and approaches for amphibious landings. This may entail marking and/or clearing channels through minefields, or less often, clearing entire minefields. The doctrine of many allied navies emphasizes maintaining a comprehensive mine warfare capability focusing on both mine laying and the neutralization of minefields.

While the allied mine warfare capabilities tend to mirror the capabilities of the U.S. Navy, there are many interoperability gaps. There are C4I gaps between the U.S. Navy and many allied navies in the area of mine warfare. Because of their small size and limited range, mine warfare platforms have limited communications suites.[55] This limited C4I capability is compounded in some navies by a concept of operations that preaches minimal contact between the MCM force and the rest of a task force.[56] Communication between the the independent mine warfare force and other elements of the coalition, such as the U.S. carrier battle group or amphibious ready group, can be even more challenging because of the lack of C4I.

Another mine warfare interoperability gap is in intelligence. This gap is particularly important where the sea area to be searched is relatively large, and intelligence is vital to finding both clear waters and mined areas in order to focus search efforts.57 One particular obstacle is that even within NATO, individual countries restrict the sharing of mining intelligence. This is a cultural issue with ties back to the Cold War when mine warfare was extremely segmented and territorial. In coalition operations, however, a high level of intelligence sharing is critical.[58]

Another related issue concerns releasability of intelligence in support of counter-mining operations. The U.S. Navy has been cautious in the past about sharing ISR

---

55 German Navy MCM ships do not have Link 11.

56 According to a German MCM officer the German Navy MCM force tends to “operate in silence.”

57 In such a scenario, intelligence about mine-laying activity and mine performance characteristics may have to be provided from satellite reconnaissance from national intelligence communities. If this is the case, releasability and bandwidth problems could inhibit the passing of this information to the dedicated MCM force.

58 Current NATO MCM exercises, such as Blue Harrier, tend to reinforce this lack of forward thinking about MCM. MCM forces tend to view operations almost as they did during World War II. What is needed, according to numerous interlocutors, is more intensive exercises that force both the U.S. Navy and its allies (including the German Navy) to think about how to provide MCM support to expeditionary operations.

(intelligence, surveillance, and reconnaissance) with allies at the outset of countermining operations for fear of compromising sources and methods. This reticence on the part of the U.S. could undermine U.S. efforts to embrace a more liberal ROE to deal with the mine threat. Allied willingness to adopt a more aggressive ROE posture during countermining operations will most likely be possible only with a clear understanding of the operational picture and the risks involved.

A final interoperability concern relates to logistics and sustained operations. A robust at-sea logistics capability is necessary to conduct multinational mine warfare operations for extended periods of time at a distances from ports. Logistics support for mine warfare vessels is complicated by: limited stowage for MCM gear and machinery parts; the large quantity of MCM gear expended during operations; and limited capacity for fuel, water, ammunition, and provisions. Reduced on-task times are necessary if the operational area is far from logistic support because of the slow transit speed of the mine warfare vessels. Currently, many allied MCM forces in the European theater rely heavily on NATO logistical structures, which strains their ability to do out-of-area operations.

The current level of interoperability between the U.S. Navy and many of its allies in mine warfare is low. Despite this fact, a high degree of interoperability may not be critical for effective combined mine warfare operations, provided that the operation is segmented and not time sensitive. Voice links are the primary means of communicating important data between mine warfare assets. Since, the basic voice links present in U.S. mine warfare platforms are NATO standard, C4I compatibility in coalition operations is unlikely to present a large problem.

Future of MCM

Several navies are committed to maintaining a capable mine warfare force well into the future. The German Navy is upgrading and modernizing its mine warfare platforms and will continue to do so over the next five years. The German Navy completed delivery of 12 class 332 minehunters, upgraded five class 343 minehunters to HL 352 mine-hunting control ships, and upgraded the remaining five to MJ 343 class advanced minehunters. The German Navy is pursuing a new program called Mine Hunting Equipment 2000 (MJ-2000). This program, which is still in planning and testing, envisions a command platform and two SEEPFERD surface drones towing underwater mine-hunting equipment. MJ-2000 is scheduled to enter service in 2006. The UK is looking to increase its operational MCM force to around 25 by 2002. The introduction of 6 Huon class minehunters into the Australian force structure should significantly augment that navy’s MCM capability.

The U.S. Navy, by comparison, is not planning additional new mine warfare platforms.[59] The U.S. Navy is putting organic MCM capabilities in CVBGs and ARGs.[60] These will rely heavily on helicopter-borne mine-clearing systems, such as the Rapid Airborne Mine Clearance System (RAMICS), the Airborne Mine Neutralizations System, and the Organic Airborne and Surface Influence Sweep. The U.S. Navy will also introduce a deployable, remotely piloted Surface Mine-hunting System (SMS) to supplement airborne MCM capabilities. As a result, the U.S. mine warfare forces will look and function less and less like those belonging to the allies.

The interoperability implications for future U.S. Navy-allied navy mine warfare operations are as yet unclear. Some believe that as the U.S. Navy adopts organic MCM, it will strain its ability to operate with allied navies due to the differences in operational tempo. U.S. ships will be able to use the organic capabilities to move quickly toward an objective, thus marginalizing the need for dedicated mine warfare assets. In addition, current C4I problems between U.S. Navy warships and the allied mine warfare force will be exacerbated because of the latter's lack of systems to support a high level of connectivity. This will make the sharing of intelligence more difficult. Other experts, however, argue that the U.S. Navy's organic MCM capability will not affect interoperability or complementarity between the two navies. It will simply allow for the U.S. Navy to conduct operations until the slower allied mine warfare force arrives on the scene.

Amphibious Warfare

Being able to move troops ashore, be it in support of humanitarian and non-combatant evacuation operations or power projection, is a capability that many navies around the world are looking to enhance. The post-Cold War era has greatly emphasized the mobility and versatility offered by amphibious forces to meet a complete range of operational scenarios; in peacetime, crisis, and conflict.

The image of amphibious warfare in the U.S. Navy is the 40,000 ton amphibious assault ship. Five Tarawa class and four Wasp class represent a commitment which no other navy could conceivably match. Even the U.S. Navy's supporting ships are highly capable and versitile, including: eight Whidby class Dock Landing Ships (LSDs) and the Harper's Ferry class cargo variant (LSD-CV). In terms of moving from ship to shore, the U.S. amphibioius fleet is outfitted with hundreds of landing craft and helicopters, such as the 91st Air Cushion Landing Craft (LCAC) and the CH-46 and CH-53 assault helicopters.

A number of key U.S. allies are also in the midst of augmenting their amphibious capabilites. The UK and Netherlands have joined together to form a combined amphibious force that is projected to be capable of strategically deploying and

59 See Jane's All the World's Ships, 1998-99 and Combat Fleets of the World: 1998- 99.

60 The first carrier battle group will be outfitted with organic MCM by 2005. It will not be thoroughly integrated into the U.S. fleet until 2010.

landing a complete Marine brigade worldwide, employing a fully integrated combined naval formation of five to eight amphibious ships plus escorts. The UK's commitment to amphibious operations was reflected in the 1998 Strategic Defense Review, which affirmed the role of amphibious forces in the new expeditionary-oriented force structure.[61] In addition, the UK has begun to enhance its amphibious shipping capability through the deployment of the 20,500 ton helicopter assault carrier (LPH)*Ocean* and procurement of two Landing Plaform Dock replacement (LPD(R)) ships, *Albion* and *Bulwark*, which will enter service in 2002 and 2003.

The Dutch component of this combined amphibious force would be provided by its new amphibious transport ship, *Rotterdam*, which recently entered service. A second ship in the class is scheduled to enter service in 2007. This ship will likely be an enhanced derivative of *Rotterdam*, including expanded amphibious command and control facilities and possibly a larger flight deck. In addition to platforms, the Dutch will also contribute a full Royal Netherlands Marine Corps battalion plus its supporting units, while they plan to provide a "balanced task group comprising frigates, helicopters, and maritime patrol aircraft, supported by submarines and mine countermeasure ships" to escort the amphibious task group from Western Europe to a crisis area where it would be needed.[62]

Spain and Italy have also combined forces, having agreed to form a joint amphibious brigade of 2000 to 3000 troops. Apart from obvious NATO utility, it is seen as being useful against drug smuggling and illegal immigration.[63] Besides these rather modest AMW missions, both countries point to more taxing missions, such as disaster relief, as providing a requirement for capable platforms.

Spain's amphibious force is evolving. It consists of the newly commissioned LPD, *Galicia*, as well as two ex-U.S. Navy 16,500 ton attack transports, each carrying 15 landing craft, and a handful of LSTs. Italy's amphibious focus is built around three 7700 ton San Giorgio class LPDs, which can each carry 400 troops plus 30 APCs or 30 MBTs. One possible advantage which Spain and Italy share is that their navies are headed by a light aircraft carrier intended for AV-8 Harrier V/STOL aircraft and anti-submarine helicopters. These would be capable of ad hoc conversion to a basic assault helicopter carrier configuration in the short term, but they lack the facilities for prolonged operation.

In Asia, both Japan and the Republic of Korea have enhanced, or are planning to enhance, their amphibious capabilites. The JMSDF unveiled the 8900 ton *Osumi* (LPH) in the mid-1990s, which raised the anxieties of several countries in the region because of its flat deck gave it the appearance of a small aircraft carrier. *Osumi* gives the JMSDF a modest lift capability, especially in defense of the outer

[61] This was done by giving the 3rd Commando Brigade, Royal Marines, a central role in the new Joint Rapid Reaction Force, and by committing to the further modernization of specialized amphibioius and sealift shipping.
[62] Comment by VADM Cees van Duyvendijk, CINC of the Royal Netherlands Navy, cited in *JIDR* (5/99).
[63] Besides Albanian problems, Italy shares Spain's apprehension of North Africa.

islands. The ROKN, on the other hand, has a well-defined requirement for new amphibious ships. It has stated a need for at least one, but possibly up to three, LPD-type unit that is to be procured under the program known as LPX. This ship would displace around 10,000 tons and would significantly enhance Korea's current AMW capability, both in terms of assault and OOTW operations.

AMW interoperability gaps

Current thinking with regard to amphibious operations in a coalition setting is to divide the tasks among the various fleets and let the operate in sectors. This reduces the need for close coordination among assets of vastly different capabilities. In addition, to date, there has been very little need for close coordination of amphibious operations. With few exceptions, amphibious assets have been used for their sealift capability.[64] A good example of this was the Dutch use of *Rotterdam*, soon after she was commissioned, to sealift Dutch Army equipment to Thessaloniki, Greece, for NATO's initial Kosovo operations in Macedonia. In other words, these units have been operated under national command to serve a complementary purpose to the overall coalition operation.

In a near term operation, interoperability gaps will most likely not be focused on amphibious units, but on support units. The movement of troops ashore, as noted above, will be carried out via a federated force structure. Task groups, which could be multinational, will be centered around major amphibious assets. Where interoperability will be most stressed will be between these assets and supporting units, such as picket defense ships and MCM assets. The pace and sequencing of amphibious operations will rely on robust C4I compatibility between these units. The fact that many allied lack the ability, both in terms of C4I and concepts of operation, to closely operate with U.S. forces under the conditions of a rapidly unfolding operation, the task force itself will have to be divided into sectors to avoid deconfliction. Another potential gap would be in the area of naval surface fire support (NSFS). The fact that the U.S. Navy is moving toward digital NSFS could cause problems in how it coordinates fire support with its allies in conjuction with an amphibious operation.

The current level of interoperability in terms of amphibious warfare between the U.S. Navy and its allies is moderate. Sectored and sequenced operations prevent the need for close coordination and assist commanders in deconfliction. In addition, allies are able to make substantive contributions in the area of complementarity, such as providing support forces, limited sealift, indigenous marine corps, and underway replenishment.

[64] The two exceptions were during the Falklands War and Operation Desert Storm. But it should be noted that in neither case were amphibious operations conducted in the face of strenuous opposition. The British landings were at points carefully selected to be free of defenses. This meant close knowledge of the Argentine strength and positions. For the British, this included the whereabouts of any naval minefields laid off the coast. The nearest the U.S. Navy and Marine Corps have come to a modern opposed assault landing was the Gulf War in 1991. There, the weight of Iraqi defenses reduced the amphibious assault option to a diversionary feint.

Future of AMW

The level of interoperability between the U.S. Navy and its allies for low intensity amphibious operations will probably remain constant for the foreseeable future. In fact, it could improve with allied development of more sophisticated command and control systems and more capable assets. One such asset is the Canadian Forces Maritime Command's future Afloat Logistics and Sealift Capability ship. Built to commercial standard, the 28,000 ton ship will have five main roles: underway replenishment support to naval forces, in-theater support to joint forces ashore, sealift, humanitarian operations, and sovereignty enforcement and surveillance.

The U.S. Navy's ability to interoperate with its allies in a high intensity environment involving opposed operations, however, could easily decline over the next decade. The primary reason for this will be a fundamental shift in U.S. doctrine toward Operational Maneuver from the Sea (OMFTS), which will require allies to operate at a much higher level and in a significantly different way than is currently envisioned in most of their doctrines.

The OMFTS vision is a response to an environment that is changing in three respects: 1) increasingly joint nature of U.S. military operations, 2) improvements in technology that can be leveraged, and 3) improvement in threat technologies. Traditionally, amphibious operations were sequenced as the large troop transport ships used smaller LSTs and LSLs to bridge the gap to the shore whereupon beach commands would be established to prosecute the next step of the operation. This allowed, at least in theory, for similar pacing between U.S. and allied forces.

Today, U.S. strategists believe that in view the enhanced threat, such sequencing of amphibious operations may no longer be viable. The number of states which protect their coastline with anti-shipping missiles is increasing. Coastal artillery has experienced a resurgence as new technology has provided for more powerful weapons. For those who cannot affort such specialized weaons, battlefield guided missiles and ordinary self-propelled artillery and fire control systems are increasingly capable of engaging coastal targets.

The U.S. solution is over-the-horizon assault. New technologies, such as the advanced assault amphibian vehicle (AAAV), the MV-22 tilt-rotor helicopter, and the already in service landing craft, air cushion (LCAC) offer new options in conducting amphibious assaults, including greater standoff distances, more flexibility in selecting beaches, greater lateral dispersion, and deeper insertions. These assault capabilities will no longer be just ship-to-shore, but allow for assaults directly from the ship to the objective which may be further inland. Supporting technologies relating to sensors, command and control, communications, and weaponry facilitate the ship to objective maneuver (STOM).

Interoperability problems associated with the introduction of OMFTS will be most noticeable in terms of doctrine and C4I. The emerging OMFTS concept requires changes to the USMC and Navy command-and-control relationships. The concept of shifting the supported commander to the landing force commander when the forces ashore have been sufficiently built up is not adequate for OMFTS. Instead, the landing force commander will need to exercise and tactical control over ground and air maneuver assets before penetrating the littoral. This underlines the importance of cohesiveness of the assault forces and the need for consistant operational tempo. If this tempo is lost, which could occur with the introduction of allied forces not thoroughly versed in the intricacies of OMFTS, the entire operation could become vulnerable.[65]

Because tactical commanders will have to adjust to changing circumstances while approaching the objective, robust C4I interoperability from ship to shore and beyond will be critical. This architecture, which will be based on a wide area network, will likely place a great strain on allied C4I capabilities. Therefore, it is very likely that opposed amphibious operations will become the sole responsibility of U.S. forces, with possible assistance from select UK forces, in the near future with allies relegated to force protection and segmented niche roles.

Conclusion

The purpose of this paper was to lay out some of the issues involved in gaining a fuller understanding and better appreciation of the concepts of interoperability. If nations truly intend their militaries to work together in response to future crises, then interoperability is a very important issue. Lack of interoperability or an "interoperability gap" may stop countries from working together. If interoperability problems do not prevent cooperation, they may make the result of that cooperation more dangerous. The prospect of increased casualties due to a lack of interoperability is not a politically fathomable concept.

If one looks at the subject of interoperability, two issues continuously resurface: what is interoperability, and for what reason is interoperability being developed? Both of these questions hover around the idea of "how much interoperability is enough?". The answer is, it depends. Interoperability must be understood contextually. In its military dimensions, interoperability is highly dependent on missions. Different missions have different levels of risk and stress different aspects of interoperability. But, ultimately for the U.S., the determination over how to conduct an operation in concert with allies results from an assessment of the threat. This implies that interoperability may have thresholds. For example, for several countries to jointly combat a high speed airborne threat, such as an anti-ship cruise missile or supersonic aircraft, the level of interoperability needed is very high, approaching seamless interoperability. Systems must be comparably capable, compatible, and connected at all levels. Information has to be used and

[65] The OMFTS vision paper states that the USMC is to seamlessly maneuver from ships to objectives ashore. This maneuver is to occur without pause or interruption on the beach.

understood the same way and shared. Only in this way can data tracks be fed from one nation to another in order to be fed to a third country's weaons system's firing solution. But, if an operation is a response to a humanitarian crisis, different countries using different procedures and equipment can still coordinate their efforts. Somewhere in between these two extremes there may be a point that is defined as reasonable interoperability; a point perhaps less than where the U.S. may be in terms of capabilities, but further along than the current capabilities of many of the allies.

Ultimately, the issue of the vaunted interoperability gap is not critical to future coalition operations. The size of the asymmetry within the gap is a more fundamental issue. Interoperability may be improved in the coming years without eliminating the gap. However, if the size of the delta grows quantitatively to such a degree that there is a qualitative shift in what the interoperability gap represent, then solutions in any single dimension of interoperability will not address the problem and the allies may find themselves unable to operate with the U.S. Navy in any meaningful way. To avoid this outcome, the gap does not need to be entirely eliminated. Even among the closest allies, differences in technology and culture will continue to exist. The best that the U.S. and its allies can hope for is to intelligently manage the gap to prevent it from metastacizing to the point where coalitions are not able to work around issues that could threaten the operation.

APPENDIX A

The NATO scale of interoperability originally evolved out of a set of standard operating procedures developed by the USN and French Navy. They have since been adopted by many NATO planners in order to study coalition operations. The NATO interoperability scale is as follows:

Level 1: Forces operate independently. Exchange of information extends to movement and intentions of forces, operations in progress, and potentially threatening activities of other nations, and includes special-interest maritime traffic.

Level 2: Operations are coordinated to optimize operational efficiency for the interests of both parties, via geographic division of areas of operations into zones of national responsibilities or by a functional division of warfare areas according to capabilities, or a combination of the two. Possible exchange of ROE. Common tactical surveillance picture possible.

Level 3: Includes mutual reinforcement of forces, by either temporary attachment or close support. Sharing tactical control allowed. ROE must be close.

Level 4: Full cooperation in operations and logistics. Combined force for a common mission. Common or comparable ROE mutually agreed upon by a higher command authority. Possible authorization of combined operations with a single operational commander.

Level 5: Seamless interoperability across all areas: C4I, ROE, logistics, full intelligence sharing.[66]

We found the above interoperability levels particularly useful for warfare areas. It is important to note, however, that USN planners to guide plans for exercises or operations with allies do not use these levels of cooperation. We use them in this study simply as a methodological basis for clarifying the degree of navy-to-navy interoperability across warfare areas.

To measure C4I interoperability between the USN and its allies, we use a different scale than the one above. NATO also created the following scale---specifically, by the headquarters directorate responsible for C4I.

Degree 1: Unstructured information exchange (exchange of human interoperable messages)

Degree 2: Structured message exchange (manual or automated handling, but manual compilation, processing)

[66] In this typology, level 1 corresponds to federated operations, while Levels 3-5 correspond to integrated command-and-control arrangements, Level 2 falls somewhere in between.

Degree 3: Seamless sharing of information (automated sharing, common exchange model)

Degree 4: Seamless sharing through a common application environment.